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Investigations on the Pathological Anatomy of Infectious Anaemia of the Horse

by

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BY

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INTRODUCTION.

In the most important horse breeding districts of Japan, such as Hokkaido, Aomori, Akita, Iwate, Yamagata and other prefectures, outbreaks of a peculiar horse disease was first noticed about fifteen years ago, and many hundreds have died. This disease is a progressive pernicious anæmia of an infectious nature, and was named by the authorities, Infectious Anæmia of the Horse.

Since almost all the affected horses are sure to die, it has aroused considerable alarm among horse breeders in Japan. So to declare the causative factors and find out the practical methods of treatment and prevention, The Special Committee for the Investigation of Infectious Anæmia of the Horse was organized by the Government in 1909, and has been put under the control of the Chief of the Bureau of Horse Administration, and the Committee has made many researches on this subject.

Since 1911 (44th. Year of Meiji), we have also made some investigations, in our Institute of Veterinary Pathology, on the Pathological Anatomy of Infectious Anæmia of the Horse, which has broken out by natural infection in the neighbouring districts of Morioka (Iwate Prefecture). The number of obducted carcasses attained to more than seventy at the end of 1914 (3rd Year of Taishō). The results of our investigations, however, do not all coincide with those of the Committee, which were reported in the "Secondary Note of Investigations."

We will mention here the brief summary of our researches on Pathological Anatomy of the disease.

PATHOLOGICAL ANATOMY.

Outer appearance.

The horses, that died of this disease are usually emaciated and anæmic, but the degree differs by the course which they took. In an acute case they hold comparatively good nutrition and usually retain the bright luster of coat. In subacute and chronic cases, on the contrary, they are markedly emaciated and anæmic.

All the visible mucous membranes are anæmic and pale and sometimes yellowish, but very rarely a dirty red colour. Anus opens loosely. Oedema often appears in the regions of the underbreast, belly, penis sheath and legs and in rare cases in the face and lips also.

Inner examination.

1) *The Subcutaneous Tissue.* In the smaller blood vessels of the subcutaneous tissue there is a small quantity of thin blood, and sometimes nothing at all. The subcutaneous and intermuscular connective tissues are a pale colour by the absence of blood, and it looks as if the animal had died from bleeding. At the oedematous part, the subcutaneous tissue is infiltrated with yellowish transparent watery exudate. From the cut ends of the large blood vessels flows out yellowish turbid serum. The blood serum of the patient very often shows more or less fluorescence or opalescence in the daylight, and in severe cases it becomes a milky pale colour. This change may also be found at the cut ends of large blood vessels or the cut surface of organ parenchym as the liver. But this change is not constant in its degree and sometimes we find a little or no change at all even in cases which showed very severe symptoms. Notwithstanding this, it is true that the fluorescence of the blood serum is rarely seen in a healthy horse. In short, in most of the acute severe cases the blood serum manifests a considerable milky turbidness with a yellowish tint, but not in all cases.

2) *The Skeletal Muscles.* In most cases the skeletal muscles are discoloured, but sometimes they show no special changes at all.

3) *The Thoracic Cavity.* In the thoracic cavity there is generally a certain quantity of transparent or somewhat turbid exudate with a tint of brownish yellow, yellow red or bright yellow, which ranges usually from

100 c.c. to one liter, and in rare cases to two liters or more. In general, the pleural membrane remains normal; but very rarely more or less turbid fibrinous matter is found.

4) *The Pericardium.* In the pericardium a large quantity of exudate is present in every case (150 c.c. —1.800 c.c., usually 300 c.c.—500 c.c.), and it is usually yellow, orange yellow, or a yellowish red colour and clearly transparent. (The exudate may be of hydraæmic nature). We found in one case hæmorrhagic exudation in the pericardium (*Hæmopericardium*). No abnormal change can be seen on the inner surface of the pericardium.

5) *The Heart.* Under the epicardium are very often found innumerable circumscribed or diffused ecchymoses of various sizes ranging from that of millet to linenseed, and the appearance of the surface is as if it were sprinkled with scarlet ink. The ecchymoses mass chiefly in the adipose tissue of *sulcus longitudinalis* and *sulcus cordarius*. The adipose tissue of the heart is changed into a gelatinous yellowish substance in consequence of atrophy of the fatty cells. The ecchymoses of the epicardium do not always occur, but we found them in about half of the obducted cases.

Under the endocardium we met frequently with petechiae, but not so often as under the epicardium. The muscles of the heart are considerably discoloured and dim, but as they contain relatively much water they hold a luster, and show no change, so that as we desire to diagnose the degeneration or swelling of musclefibers we must necessarily perform the microscopical examination. In the acute cases the musclefibers of the heart show very often considerable degeneration, and microscopically lose their striaæ and are filled with fatty granules. However this change is not constant and sometimes no change is seen in an acute case.

In the chronic case, on the contrary, usually no change is found in the musclefibers, while very rarely an increase of intermuscular connective tissues may be met with. We found frequently the local fatty degeneration of the musclefibers and the capillary blood vessels of the heart, which we imagine due to the change of the character of the blood. For example:—

a) *Nakasato.* 3-year-old brown mare, died in subacute course.

On the outer surface of the heart were scattered many pale white spots from the size of millet to that of a bean, and the center of the spots showed a light red colour. Such spots were also found in the innerpart of the muscles. At the right side of the heart these spots, amalgamating with each other, formed diffuse patterns.

Microscopically (freezing section, stained with hæmatoxylin =sudan III) the musclefibers of the lesion were filled with red fatty granules, some of the fibers atrophied, the walls of the capillary vessels of the lesion stained red with sudan III, (the fatty degeneration), and even the walls of the small arteries also infiltrated with fatty granules.

b) *Kizashi,* 14-year-old brown mare, died in acute course.

On the tricuspid valve was found an echymosis of the size of a pea, and under the endocardium a few indefinite ones. In the inner part of the heart muscles some red brown spots from the size of the pea to that of the hazel were scattered here and there.

Microscopically connective tissues increased in the musclefibers and the musclefibers of this part atrophied, while the neighbouring fibers showed fatty degeneration. The capillary vessels and the small arteries near the lesion stained red with sudan III.

c) *Iwane*, 13-year-old black mare, died in acute course.

The heart was relaxed and flabby, containing a large volume of blood in the right ventricle. On the outer surface of the heart, especially on the right, were scattered many pale white spots varying in size from that of millet to the bean.

Microscopically the musclefibers in the lesion lose their striae and filled with fine fatty granules. The capillary vessels and small arteries stained red with sudan III.

5) *The Lung.* In almost all cases the lungs remain in a half inspirating condition ; the outer surface is rose red, pale, or whitish pale colour and the cut surface is very juicy, which is due to the agonial œdema of the lung, but with less blood. The trachea and the bronchia contain much white foam. In some parts of the lung is sometimes found atelectasis, where the tissues were of a dark red colour and show some depression. In an old one an increase of connective tissues are recognizable and the part very compact. Microscopically the walls of the air vesicles are somewhat thickened and deposits of hæmoglobingranules are found.

6) *The Peritoneal Cavity.* In a subacute case the adipose tissues of the peritoneal cavity are atrophied and remain only as yellow coloured connective tissues.

7) *The Stomach.* In almost all cases the stomach contains a medium amount of well masticated food mass, and the mucosa is anæmic and pale. Sometimes on the mucosa of the fundus hang some Œstrus larvae.

8) *The Small Intestines.* The mucous membrane of

the duodenum and the anterior portion of the jejenum often shows a slaty colour, and seldom red or reddish brown. The small intestines generally contain a sticky jelly-like substance with a tint of brown or yellowish brown.

9) *The Large Intestines.* In the large intestines generally no special change is found.

10) *The Liver.* In carcasses which died in acute or subacute course or even in a chronic course, where the animal showed a very severe symptoms, we found mostly the *hepatic engorgement* and *hypertrophy.* We think these are the most important changes for the pathological anatomical diagnosis of the Infectious Anæmia, as it is very rare in any other horse disease to find the circulatory disturbances attended with the hepatic change.

In an acute case the liver is enlarged twice or thrice of its normal weight. The liver of the diseased horse weighs from seven to thirteen kilograms, while a normal one probably will weigh from four to five kilograms. In one case the weight attained over sixteen kilograms.

The weights of the livers in acute cases, extracted from our obduction's protocol, are as follows :—

Year.	No. of section.	
1911	S. N. 1	much enlarged.
	S. N. 2	fairly enlarged.
	S. N. 5	13.5 kilograms.
	S. N. 10	much enlarged.
	S. N. 11	fairly enlarged.
1912	S. N. 42	12.7 kilograms.
	S. N. 45	13.0 ,,
	S. N. 48	10.0 ,,

Year.	No. of section.	
1912	S. N. 52	fairly enlarged.
	S. N. 53	15·3 kilograms.
	S. N. 59	7·4 ,,
	S. N. 60	fairly enlarged.
	S. N. 62	much enlarged.
	S. N. 66	15·5 kilograms.
	S. N. 69	10.0 ,,
	S. N. 71	8.0 ,,
	S. N. 72	7·4 ,,
	S. N. 73	10.0 ,,
	S. N. 81	9.2 ,,
	S. N. 84	7·95 ,,
	S. N. 85	8.05 ,,
	S. N. 93	16.0 ,,
1913	S. N. 104	13·5 ,,
	S. N. 108	7.0 ,,
	S. N. 101	10.35 ,,
	S. N. 112	7.0 ,,
	S. N. 114	10.0 ,,
	S. N. 118	10.05 ,,
	S. N. 119	9·75 ,,
	S. N. 124	9·85 ,,
	S. N. 137	9·4 ,,
1914	S. N. 152	9·1 ,,
	S. N. 155	much enlarged.
	S. N. 156	10.85 kilograms.
	S. N. 163	14·85 ,,
	S. N. 164	12.0 ,,

On the cut surface of the liver we found reddish or dark reddish net-like flecks scattered on a pale or yellowish pale ground. The flecks correspond to the enlarged central veins of acini and the more extreme the engorgement, the more evident and larger the net-like flecks, and shows so-called "*hepa moschateforme.*"

On examining the microscopical section of liver, stained with hæmatoxylin=sudan III, the central vein of acinus and its vicinity was filled with blood corpuscles, and in consequence of this pressure the liver cells of this part were atrophied or disappeared. In severe cases the liver cells remain only at the outer periphery of the acinus. In the highly engorged acinus the liver cells near the center are infiltrated by fatty granules and the cells seem to begin their disappearance by fatty degeneration gradually from center to periphery. The interlobular connective tissues are infiltrated more or less with round cells.

The chronic case, which begins with a severe symptom and then changes into chronic, shows the same microscopical changes as in the acute, that is, the liver is enlarged accompanying the swelling of the margins, hard and compact, and its cut surface shows beautiful nutmeglike flecks. In this case the histological changes somewhat differ from those in the acute course; that is, the intercellular capillary vessels of acinus are enlarged and form a network or caverns, and therefore the liver cells around the central veins are markedly atrophied. The sphere of capillary dilatation (*teleangiectasia*) often attains to the size of a bean or a pea. In some parts of the acinus there are found epitheloid round cells aggregated here and there, and among interlobular connective tissues infiltration of small round cells.

In the carcasses, which died in slight course, at first no change can be seen in the livers, and in the cases which have developed into chronic, the livers are enlarged more or less, consistency becoming hard and compact, and sometimes a slight engorgement is also found. Often they show a yellowish colour on account of the retention of the bile. *Microscopically* the accumulations of the round cells are sometimes found around the central veins and between the liver cell-cords. The bile pigment is also deposited in the liver cells around the central veins. In the capillaries of the biliary ducts retention of the bile sometimes takes place. The interlobular connective tissues generally increase and are infiltrated with round cells. When the course, though slight and chronic at first, shows a severe symptom at the end, it complicates more or less acute changes microscopically.

11) *The Spleen.* The spleen is enlarged more or less by the presence of the engorgement, attaining twice or thrice of its normal size (weighing one to three kilograms). At the newly engorged spleen, the cut surface is dark red or dark red brown colour and rather tender in consistency, instead of being quite compact as an old one. Although we met very often with the engorgement of the spleen in the carcasses of diseased animals, yet there are many cases where the spleen remains in a normal condition, or if enlarged, it is due to the increase of the lymphatic cells. In this case the consistency is compact and the cut surface has a reddish brown colour. In a fresh scratched preparation and in a microscopical section we found yellowish brown coloured granules, which show a marked hæmosiderin reaction. In short,

most of the cases showed a splenic engorgement and engorgemental hyperæmia ; but it was not the special change, and we have seen a few normal ones.

12) *The Lymphatic Glands.* The lymphatic glands in the peritoneal cavity, such as mesenteric, hepatic, splenic and renal glands manifest a red or dark red colour, the cut surface is very rich in blood, and sometimes enlarged also, though the degree is not so great.

13) *The Kidney.* As a rule the kidney is enlarged and often attains to the weight of one kilogram or more. The cut surface is discoloured, and the *cortex* shows a yellowish pale colour, which differentiates from the simple yellowish colour of the non-infectious anæmia. The substance of the kidney is usually of a compact consistency.

On the cut surface of the cortex we sometimes met with a few or many hæmorrhagic spots varying in size from a pinhead to that of hempseed. In one case we recognized wedgeshaped anæmic infarctus. On the fresh scratched preparation, the epitherial cells of *tubulus uriniferus* sometimes remain quite normal, sometimes manifest cloudy swelling, and very rarely fatty degeneration. In the glomeruli are frequently found yellowish brown amorphous granules (*hæmoglobingranules*).

Microscopically, the interstitial substance of the cortex, especially around the small arteries and glomeruli, are infiltrated more or less with small round cells, occasionally they are very abundant.

Occasionally some of the nuclei of epitherial cells of *tubuli uriniferi* stand bold against staining solution, and the tubuli intermingling normal ones show the appearance, as may be seen in acute nephritis, but the macroscopical determination of this change is very difficult. Sometimes a little increase of the interstitial connective tissues is seen in the cortex and rarely in a very remarkable increase. In the latter the *tubuli uriniferi* are atrophied, and show the change of so-called "Chronic Interstitial Nephritis." In a few cases the fatty degeneration of small arteries and capillary vessels of the cortex are recognizable, and may be stained red with sudan III.

14) *The Urinary Bladder.* No changes in the bladder, but often we find a large quantity of urine contained in it.

15) *The Bone Marrow.* The bone marrow of long bones, such as the humerus and femur, changes wholly or in part into red, red brown, or dark red. *Microscopically,* lacking of fatty cells, rich in small round cells, and very rarely some eosinophile cells are found. But such a colour change of the bone marrow is not a usual one, and sometimes not seen even in the severe cases.

The above mentioned anatomical and histological changes are the summarizing protocol which we have derived from our observations, on many dissected carcasses, which died because of natural infection in the Morioka District.

In very mild cases, which did not terminate in death, no special changes can be recognizable, and also the same in the case which showed only reactive fever by artificial inoculation.

EXAMPLE OF THE CASES.

The following are the five representative obduction protocols.

Case I.

(An acute case.)

Tamayama, 2-year-old brown foal.

History of the patient. This patient came to our hospital July 29th, 1911 (44th year of Meiji). According to his owner, the patient first decreased in his appetite about twenty days previous and began to emaciate gradually.

Symptoms. The patient still holds a moderate nutrition, the coat bright, but his spirit somewhat depressed, and does not seem to take any care for the swarming flies; all the visible mucous membranes pale, the thoracic wall waves slightly at the corresponding portion of the heart, the first heart sound high and complicates secondery murmurs, the sounds can be heared even at the flank, the pulse very rapid with medium strength, the venous pulse of the jugular vein remakable. No appetite, the noise of the peristaltic motion is intermingled a metalic sound, the feces small and hard covered with slime, the anus opens widely, the patient repeatedly excrets a small quantity of urine (the urine clear, and reaction acid, specific gravity 1.015, no albumin). Legs, lips and cheeks edematous. The walk unsteady especially on hind legs, dragging the feet along the ground. The bodily temperature 39.5°C., the pulse 108, the respiration 20.

Any recognizable change of symptom was not observed henceforward, excepting the disappearance of the edœma on legs. On August 4th. the patient lay down on the ground and died at 11 a.m.

Obduction Protocol.

Died at 11 a.m. on August 4th, 1911.
Obducted at 2 p.m. of the same day.

Outer appearance.

Very emaciated, all the visible membranes pale with a tint of yellow. The penis droops down, dropping urine from its end.

Inner examination.

The Subcutaneous Tissue. All over the body it is juicy especially at both hind legs. At the belly is found an infiltration of yellowish watery liquid. From the intermuscular connective tissues also the same liquid squeezes out.

The Pericardium. In the pericardial sac is contained about 600 c.c. of clear, transparent yellowish exudate, while the pericardial membrane shows no change.

The *Heart.* The heart is somewhat constricted and some yellowish fibrin mass and dark red coagulates of the blood are contained in right ventricle, and some in the left also. The tricuspid valves are thickened a little at the margin. The heart muscles are discoloured and lusterless. *Microscopically* the muscle fibers show more or less cloudy swelling, losing their striae, and in some parts the muscle fibers are filled with fatty granules.

The Lung. The surfaces of the lungs are a light red colour. From the cut surfaces of the upper margins of both lungs flows out much watery liquid, mixed with much foam, and in the trachea and the bronchia is also contained much white foam.

The Stomach. The stomach contains only a little quantity of well masticated food. The mucosa is anæmic pale, and a large number of Œstrus larvae hang at a part of the fundus and the beginning of the duodenum.

The Small Intestines. In the duodenum and the jejunum the villi are reddened at their points, some are slaty colour. The contents are thick, viscid and yellowish, especially in the duodenum. In the ileum is contained a dark blackish food mass.

The large Intestines. No special changes are met with in the large intestines.

The Liver. The liver is markedly enlarged, especially increasing in thickness. The cut surface shows large netlike flecks of a dark red colour on a pale yellowish ground, and squeezes out thin blood. On the scratched preparation, liver cells show more or less cloudy swelling and some of them fatty infiltration.

On the *microscopical section,* the liver is under the engorged condition ; that is, the central vein and capillary vessels of the acinus are markedly widened, the liver cells are atrophied at the central part, and some are wholly replaced by round cells or increased connective tissues. In the interlobular connective tissues and along intralobular capillary vessels are accumulated very many round cells also. On the freezing section stained with hæmatoxylin=sudan III, the remaining liver-cells near the central vein contain beautiful red stained small fatty drops or granules.

The Spleen. The spleen is enlarged about twice of its normal size, consistency compact, and the cut surface shows a reddish brown colour.

The Lymphatic Glands. All the lymphatic glands in the peritoneal cavity are more or less enlarged, and markedly reddened.

The Kidney. Somewhat enlarged, the cut surface very juicy, and the cortex yellowish pale.

On fresh scratched preparation, the epithelial cells of the *tubulus uriniferus* are infiltrated with fatty granules.

On the section the *tubuli uriniferi* of cortex are widened and the epithelial cells flattened. In some parts along the capillary vessels cellular infiltration is recognizable.

The mucosa of the ureter is covered with pale membranous masses.

The Bladder. The bladder is dilated and filled with about five litres of the urine which is very clear and of a yellowish brown colour, the specific gravity being 1.017, reaction acid.

Pathological Anatomical Diagnosis.

1. General Anæmia and Hyderæmia.
2. Hydropericardium.
3. Degeneration of Myocardium.
4. Catarrhal Enteritis of Small Intestines.
5. Engorgement and Hypertrophy of the Liver.
6. Hyderæmia of the Spleen.

Case II.

(an acute case.)

Semboku, 8-year-old brown stallion.

History of the Patient. The patient was brought to our hospital at June 22nd, 1912. The patient had been used for draft-work, the owner said, until about ten days before when he had discovered his appetite had decreased, and the spirit somewhat depressed. Two or three days before, some œdema were found at the belly, penis sheath, and the lower parts of legs, and the general condition has become worse.

Symptoms. The patient still holds a good nutrition and the coat luster, and has some œdema at the belly, penis sheath, scrotum and legs, and there remain finger-marks on pressure. The step is dull and stagging. In the loose box the patient stands always against a corner, hanging down his head melancholily. The visible mucous membranes pale, the appetite decreased, the peristaltic motion suppressed, the feces dry and small. The bodily temperature 39.9°C., the pulse 73, strong and positive, the heart beat accelerated and the first sound high, the venous pulse recognizable in the jugular vein. The urine clear and greenish yellow with acid reaction, specific gravity 1.015, and no albumin. The counting of red corpuscles showed the number of 4,000,000.

June 23rd.—The general condition of the patient is worse with increased melancholy, the conjunctiva reddish, the appetite and the peristaltic motion depressed, the feces dry and small, the anus loosened, the extent of the œdema increased, the skin temperature irregular, the bodily temperature 42.0°C., the pulse 86.

June 24th.—The patient is very weakened, visible membranes markedly dark red, and no appetite.

Afternoon of the same day.—Defecation of muddy feces, the patient is lying down on the ground and can not stand up anymore, the heart beat accelerated, the sound of the heart large and can be heard at some distance, the bodily temperature 40.2°C., the pulse 112. The breathing depressed and groaning. At 1 a.m. on the 25th, he died.

Obduction protocol.

Died at 1 a.m. on June 25th, 1912.
Obducted at 11 p.m. of the same day.

Outer appearance.

The carcass holds medium nutrition, some œdema are found at legs, underbreast, and belly; the conjunctiva manifest dirty yellowish red spots, the nasal discharge is clear and yellowish red, and the mucous membranes of nostrils very pale. The anus loosened.

Inner examination.

The Subcutaneous Tissues. Under the skin, the adipose tissues are markedly atrophied, and nearly bloodless in the small subcutaneous veins. In the subcutaneous tissues of the belly the œdema is observed. All the muscles are markedly discoloured. From the cut ends of larger blood vessels flows out some turbid blood plasma.

The Thoracic Cavity. In the thoracic cavity is contained about one liter of turbid, yellowish brown exudate.

The Pericardium. In the pericardial sac is also contained 300 c.c. of little turbid, orange yellow exudates.

The Heart. On the epicardial membrane are scattered innumerable scarlet red or dark red petechiæ ranging in size from a pinhead to millet corn. In the ventricle is contained a large quantity of blood coagulates. The heart muscles anæmic discoloured and lusterless.

Microscopically the muscle fibers show more or less cloudy swelling.

The Lungs. The lungs are in a half inspirating condition, and on the surface of the right one there are some flecks of bright or dark red colour, of which the dark portions show atelectasis. As to the left one it has an emphysem on its lower margin. The cut surface of the right lung is juicy, while that of left one lacks the blood.

The Peritoneal Cavity. In the peritoneal cavity is found some turbid, red brown exudates, and on the serous membrane of the bowel are studded innumerable bright and dark red coloured petechiæ of the size of millet-corn.

The Stomach and the intestines. The stomach is almost empty, and contains only a small quantity of yellowish brown food mass, its mucosa remaining in quite a healthy condition. On the mucous membrane of the duodenum and the anterior portion of the jejunum, the villi show a slaty colour at their points, and the contents a more or less darkish colour. The mucous membrane of the ileum seems very shrinky with many transverse folds.

In the large intestines is contained a medium amount of food rich in water.

The Liver. The liver is enlarged with rounded borders, weighing 12.7 kilograms. The cut surface shows dark red, fine net-like flecks on a yellowish pale ground, which is due to the engorgement of the liver, and squeezes out thin blood. On the *microscopical* preparation stained with hæmatoxylin=sudan III, the liver cells have entirely disappeared, in the neighbourhood of the central vein of the acinus, and instead of which round cells have accumulated.

At the severely affected part, the disappearance of the cells is seen even at the outer periphery of the acinus. The remaining liver cells are infiltrated with fatty granules, especially those nearest to the central vein.

The Spleen. Much enlarged and weighs about 2.8 kilograms. The cut surface dark red while the splenic pulpa has a soft muddy consistency.

The Lymphatic Glands. All the lymphatic glands in the peritoneal cavity are reddened and congested.

The Kidneys. The kidneys are flaccid, the cut surface juicy and the cortex very pale.

The Bladder. The bladder contains about four liters of brownish, and somewhat turbid urine.

Pathological anatomical diagnosis.

1. General Anæmia and Hydræmia.
2. Hydropericardium.
3. Degeneration of Myocardium.
4. Engorgement and Hypertrophy of the Liver.
5. Splenic Hyperæmia.
6. Œdema of the Lungs and Atelectasis.

7. Ecchymosis of the Peritoneal Serous Membrane and the Epicardium.

Case III.

(an acute case.)

Ishimata, 5-year-old black mare.

History of the Patient. Once in the Spring, the mare suffering from rheumatismus, was put under medical treatment. Thereafter no change was noticed in her health except a somewhat lessened appetite a few days before. On the morning of August 12th, after traveling about eight miles distance under some burden, she suddenly fell down on the road and soon died notwithstanding a veterinarian's treatment.

Obduction Protocol.

Died at 9 a.m., on Sept. 12th, 1914.
Obducted at 11 a.m. of the same day.

Outer appearance.

The carcass has a good nutrition and a bright coat luster. The rigor mortis is not come. All the visible membranes pale, the anus loosened. By the punction of the jugular vein we get only some serous liquid instead of the normal blood.

Inner examination.

The subcutaneous veins contain only a small quantity of blood. On the left side of the neck there is an injection trace of tincture of camphor. All the *adipose* and the *subcutaneous tissues* of the body are yellowish, while the *skeletal muscles* hold their normal tinge. In the blood which flows out from among the tissues, the plasma and corpuscles are markedly seperated.

The Thoracic Cavity. In the thoracic cavity no abnormal exudates are present.

The Pericardium. In the pericardial sac about 900 c.c. of clear yellowish exudate is present, but no change is recognizable on the membrane.

The Heart. The adipose tissues which are stored in the sulci of the heart, are changed into yellowish gelatinous masses and very flaccid. The *ventricles*, especially at the right one relaxed and flabby, and contain a large quantity of fibrinous coagulates. The heart muscles are almost juiceless, but hold still their normal luster. Under the *microscope*, the musclefibers show some dim swelling.

The Lungs. The lungs are in a half inspirating codition, the outer surface rose red, the cut surface juicy and from the cut ends of bronchi flows out watery liquid mixed with white foam. The surrounding connective tissues of the trachea show yellowish colour and the trachea is filled with much white foam.

The Peritoneal Cavity. Of the situation of the viscera no abnormality is noticed. The mesenteric glands are somewhat enlarged and congested. At the trunk of the anterior mesenteric artery is found a verminous aneurism of the size of a walnut.

The Stomach. In the stomach is contained a medium quantity of well masticated food mass of yellowish green colour. On the mucous membrane of the pylorus are diffusely scattered bright flecks and some Œstrus larvæ hang there.

The Small and Large Intestines. The duodenum contains a yellowish brown sticky substance, and the villi of the anterior part of the jejunum show a red tinge and are covered with a yellowish pale muddy substance. The posterior part of jejunum contains dark muddy food masses. On various places of the mucous membrane of the small intestines are diffusely scattered flecks of red or dark colour. Under the mucosa are found a few tubercules of the size of a bean which consists of compact connective tissues, and each has a dry pus-like substance in its center. The cœcum contains watery contents and in the colon waterless food mass of medium volume. Some red flecks are diffusely scattered all over the mucosa.

The Liver. The outer surface of the liver has a darkish red brown colour, and it is considerably enlarged with rounded margins, weighing 14.850 grams. The cut surface shows thick, dark red, net-like flecks on the yellowish brown ground.

On the fresh scratched *microscopical* preparation the liver cells show a granular swelling and some contain a yellowish brown pigment.

On the *microscopical* section, the liver cells, which are located near the central vein of acinus, has a yellow bile pigment deposited and in the intercellular tissues is found the deposition of amorphous hæmoglobin granules.

The Spleen. The spleen very enlarged, weighing 2.225 grms. The cut surface shows a dark reddish brown colour and the *Malpighian corpuscles* attain to the size of a hempseed.

The Kidneys. The kidneys pretty enlarged, the cortical portion yellowish, the medullary substance pale, and the intermediate layer more or less reddish.

Pathological Anatomical Diagnosis.

1. General Anæmia and Hydræmia.
2. Hydropericardium.
3. Engorgement and Hypertrophy of the Liver.
4. Catarrhal Enteritis of the Small and Large Intestines.
5. Hypertrophy of the Spleen.

The above mentioned three cases are the typical ones of Acute Infectious Anæmia and the same may be said of the anatomical changes.

Case IV.

(a chronic case.)

Fukuda, 13-year-old black mare.

History of the Patient. The patient was brought to the hospital on Sept. 2nd, 1912. In the Spring the patient had been sent to pasture. About one month ago, the owner noticed for the first time the depressed condition of the animal and an abnormally high bodily temperature.

Symptoms. At first the nutrition was bad and the coat luster wholly lost. Both the hind legs œdematous, and the patient showed a dull and fatigued appearance. The conjunctiva pale, the appetite depressed, the heart beat accelerated, the venous pulse recognizable at the jugular vein, the peristaltic motion normal. The bodily temperature 39.2°C., the pulse 102, the respiration 24 per minute. The urine was somewhat turbid and alkaline, specific weight 1.027.

Thereafter the patient recovered his appetite and ate up all his rations, but the heart beat was greatly accelerated, and the number of the pulse was counted 80–125 per minute. The bodily temperature ranged from 37.0°C. to 39.0°C. The number of red corpuscles decreased from 2,200,000 (on Sept. 20th) to 1,440,000 (on Oct. 29th). These severe symptoms continued for about two months and from Oct. 27th the patient began to discharge bloody urine. The heart beat became worse and she died on November 11th.

Obduction Protocol.

Died at 11 p.m. on Nov. 6th, 1912.
Obducted at 10 a.m. on Nov. 7th.

Outer appearance.

The nutrition is very bad, and all the visible mucous membranes are pale, anus loosened.

Inner examination.

The Subcutaneous Tissues and the Skeletal Muscles. The subcutaneous connective tissues of the underbreast and belly are infiltrated with yellowish exudates, and the other parts contain less blood and rather dry. From the cut ends of the large blood vessels flows out only the milky plasma. The skeletal muscles are generally discoloured.

The Thoracic Cavity. In the thoracic cavity about 160 c.c. of clear transparent, orange yellow exudate is present, and in the left, 250 c.c. of the same exudate.

The Pericardium. In the pericardial sac is contained 2.100 c.c. of clear, transparent yellowish exudates.

The Heart. The epicardial membrane of the right side of the heart is slightly turbid and has some pale villous fibers on its surface. The heart is relaxed, dilated and flabby, and though the muscles are discoloured, the luster remains normal. The muscles of the right side of the heart show dark red hæmorrhagic spots near by the transverse furrow. A tricuspid and a bicuspid valves are swollen, increasing their connective tissues, and are a yellowish pale colour.

The Lungs. The lungs are in a half inspirating condition, the cut surface very juicy, and in the trachea and the bronchi some white foamy liquid is present.

The Peritoneal Cavity. The position of the viscera is normal.

The Stomach and the Intestines. In the stomach is found a large quantity of well masticated food mass, the mucosa is pale, and a few Œstrus larvæ are hanged at the pylorus. The points of the villi of the duodenum are brown, and those of the posterior part of the duodenum and jejunum show a slaty colour, and the contents are yellowish pale and muddy. The content of the ileum has a chocolate colour and is mixed with dark red blood coagulates. The contents of the large intestines are rich in water.

The Liver. The liver is enlarged especially at the right lobe, and weighs 9.5 kilograms. The colour of the surface is yellowish brown, and the cut surface shows dark red net-like flecks on the yellowish pale ground.

Microscopically, the liver cells are atrophied and flattened, especially around the central veins, and the intercellular capillary vessels are dilated and form a net-like structure. Around the central vein the connective tissues are increased, and the epitheloid cellular infiltrations are frequently recognizable at various places in the acinus.

The Spleen. The size, weight and consistency is normal, the cut surface shows a dark red tinge, and Malpighian corpuscles are indistinct.

The Kidneys. The consistency of the kidneys is flaccid and juicy, the colour of the cut surface is yellowish pale, and they contain less blood.

Microscopically is found slight cellular infiltrations at various places of the intercellular substance and around the small arteries.

The Bladder. In the bladder, dark red coagulates of blood are present and the mucosa is covered with pale sediments.

The Bone Marrow. At some parts the bone marrow of the femur changed darkish red, but mostly it retains lardaceous white colour.

Pathological Anatomical Diagnosis.

1. General Anæmia and Hydræmia.
2. Hydropericardium.
3. Engorgement and Hypertrophy of the Liver.

4. Hæmorrhage in the Bladder.
5. Hæmorrhage in the Small Intestine.
6. Hypertrophy of Valvula cordis.

This is the example of obduction done on the carcass which died after a prolonged severe course.

Case V.

(a chronic case.)

Matsuzaki, 2-year-old chestnut foal.

History of the patient. The decreased appetite of the patient was at first noticed on the 10th of November and thence he became very dull, and the swelling of all his legs was general. The bodily temperature 39.2°C., the pulse 60, the respiration 10. Thereafter the temperature fell down to 38.0°C. or so.

Symptoms. The patient was brought to the hospital on November 6th. At that time the patient had bad nutrition and the general condition was that of depression, but still held his normal appetite. Oedema was seen at the lower portions of all the limbs. All the visible mucous membranes were pale, and the peristaltic motion, the defecation, and the excretion of the urine normal. On the ausculation of the heart murmurs could be heard. The bodily temperature 38.5°C., the pulse 85. Hereafter the temperature fell to 38°.0°C. or so, the number of pulse beats decreased to 54—60 per minute. The number of red corpuscles was decreased 2.720.000 in 1 c.m.m.

From the middle of December, the temperature rose a little, but not exceeded 38.9°C., the number of pulse beats ranged from 60 to 70 per minute.

From January to February there was no change in the general condition of the patient excepting the increase of the red tinge of the conjunctiva. The bodily temperature 38.0°C. or so, the pulse 50 to 60. During the latter half of February the bodily temperature remained below 39.0°C. In March the temperature fell to 38.0°C. or thereabout, though at one time it rose to 38.8°C. On March 13th the counting of red corpuscles showed the number of 3.311.000 in per c.m.m. The above general conditions continued to 21st of April when the patient was assigned a revolving exercise in trott and thereafter the patient began to show irregular recurrences of fever.

On April 23rd, the bodily temperature rose to 39.6°C. and the number of pulse was 70—80 per minute, which reached over 90 on May 3rd.

The patient died from bleeding at 11 a.m. on May 30th, the entire volume of the hæmorrhage measured only three liters.

Obduction Protocol.

Died from bleeding at 11 a.m. on May 30th, 1913. Obducted at 2 p.m. of the same day.

Outer appearance.

Nutrition bad, the coat lusterless, and the visible mucous membranes pale.

Inner examination.

The subcutaneous veins are poor in blood, and the subcutis rather dry. From the cut end of jugular vein flows out the yellowish, milky white serous liquid.

The Thoracic Cavity. No abnormal exudate in the thoracic cavity.

The Pericardium. In the pericardial sac 630 c.c. of transparent yellowish exudate is present, but no change on the membrane.

The Heart. The outer surface of the left side of the heart shows diffusely scattered petechiæ here and there ; the heart muscles are anæmic discoloured, and a little yellowish ; no change on the endocardium.

The Lungs. The lungs are in a half inspirating condition. The outer surfaces are pale and yellowish, and from the cut surfaces flows out a large quantity of watery liquid. Some thromobotic masses are found in the small veins of the lungs, and the trachea is filled with much white foam.

The Peritoneal Cavity. The peritoneal and visceral serous membranes are pale and a few *Filaria equina* are found in the cavity.

The Stomach and the Intestines. In the stomach there is only a small quantity of the food mass and on the mucosa of the cardial portion hang many Œstrus larvæ. In the duodenum and jejunum a number of *Ascaris megalocephala* (180) are present. The mucosa of the small intestines has many folds and shrinky, and covered with a sticky yellowish white substance. In the posterior part of the jejunum and ileum is contained a glutinous jelly like substance. The colon contains a large volume of food, and the mucosa remains in its normal condition. In the vein of colon (*anterior mesenteric vein*) are found three thrombi, and one of them measures 10 c.m. in length and 1 c.m. in diameter, a part of it adhering to the wall of the vein.

The Liver. The liver somewhat enlarged, weighs 5.6 kilograms, the cut surface shows a greenish and yellowish brown colour, and the small biliary ducts contain a sticky yellowish bile, and in the small veins are found small thrombi here and there. On the *fresh scratched preparation* the liver cells are infiltrated with fatty granules or bile pigment.

On the *section* (stained with hæmatoxylin=sudan III) the increased interlobular connective tissues are infiltrated with round cells, the liver cells near the central vein have disappeared, the remaining ones being infiltrated with fatty granules.

The Spleen. The spleen is somewhat enlarged, weighs 1.4 kilograms, the consistency compact, the cut surface reddish brown, and *Malpighian corpuscles* distinctly recognizable. In the splenic vein is found a thrombus, about 10 c.m. long.

The Kidneys. Both the kidneys are enlarged, each weighing 850 grams, the cut surface of the cortical substance has a yellowish tinge, and the glomeruli red and distinctly recognizable.

Microscopically the epithels of the tubulus uriniferus are flattened and a considerable increase of the connective tissues is found in the cortical substance. The glomeruli contain many brown granules here and there and stain red with sudan III.

The Brain. Although the vessels of the brain contain less blood, the substance remain quite normal.

The retropharyngial lymphatic glands are swollen to the size of a hen's egg, and contain concentrated pale pus.

Pathological Anatomical Diagnosis.

1. General Anæmia and Hydræmia.
2. Hydropericardium.
3. Ascariasis.
4. Œdema of the Lungs.
5. Bile Retention of the Liver.
6. Splenic Hypertrophy.
7. Chronic Nephritis.

The above are the important changes, which have been found in chronic cases, and distinguishable from those of the acute and subacute cases mainly by the absence of the engorgement of the liver, although the bile retention may often be found. As in this case the patient showed some severe symptoms at the end of the course, the histological changes somewhat resembled those of an acute case.

After remarks.

Finally we have some facts to mention here which have been derived from our experiences, namely,—

1). According to the report of the Special Committee for the Investigation of Infectious Anæmia among Horses in Japan, it seems to be an easy matter to develop a fatal course by the artificial inoculation of the horse. But in our few experiments we have never observed such a case, although the animal showed a typical feverish reaction. Probably the fact may be attributed to the individual constitution or immunity, but we have not as yet demonstrated these facts to our satisfaction, and desire to solve by further experiments.

2). The patient can recover by sanitary treatment, as may be seen in the Remount Depôt, if the disease is mild or if it is discovered in the early stages. On the contrary, among farm horses the discovery of the disease is very rare, because, among farmers the sanitary management can not generally be practiced because of the economical conditions. This state of things is lamentable in that most of the patients gradually fall into severe conditions, and all treatment becomes ineffectual. The patients which were found in the neighbourhood of Morioka, all showed such a tendency.

3). According to the investigations of the Committee, the disease is transmitted by insects usually at the pasture. While the virus is not retained in the pasture, the terrible spread of the disease is due chiefly to the intermingling of the horses while at the pasture during the summer.

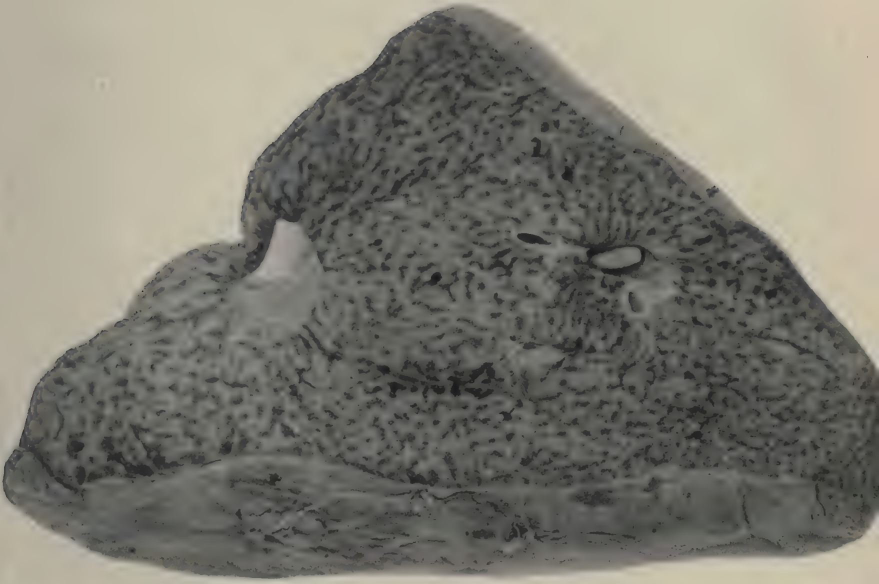
This is the most important fact for the practical prevention of the disease, so that if we hope to succeed in suppressing the disease, the pasturing of diseased horses must be absolutely forbidden. For this reason it will be most necessary thing to allow the veterinary surgeons to examine constantly the pastured horses. And if a diseased or suspected one be found, allow it to be taken to the stable without delay.

4). To put this plan into practice is most embarassing. The fact is, that among horses of the infected districts there are many perplexing virrus carriers which appear quite healthy. There must be a mean found to differenciate between the real sound ones and those which are affected.

5). Therefore as to the plan of prevention the three following ways are suggested,—

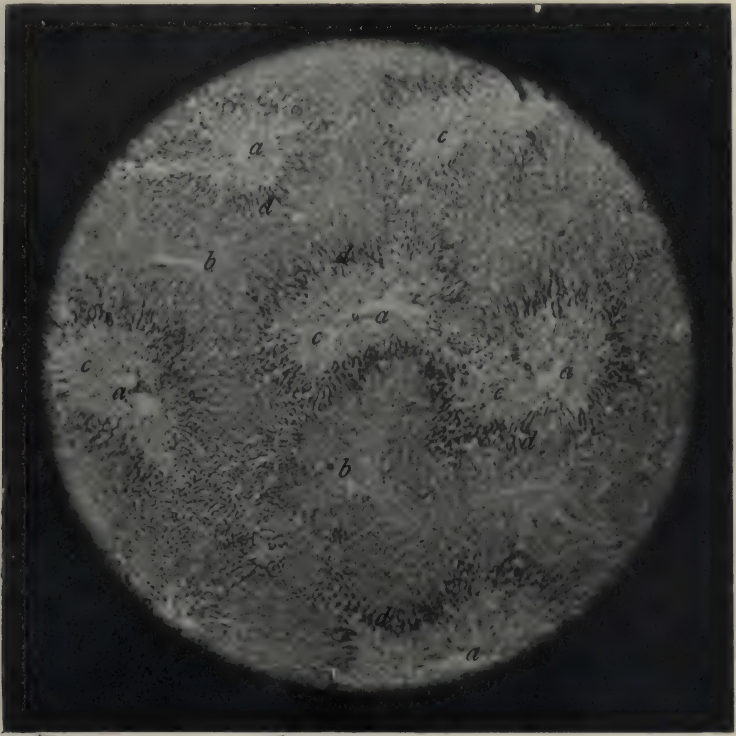
a) To absolutely forbid the pasturing of an infected animal.
b) Strict examination of the horse before pasturing.
c) In the much infected districts, to provide a special pasture for infected animals.

Plate I.



Macroscopical view of the cut surface of the engorged liver of Infectious Anæmia of the Horse.
Natural size.

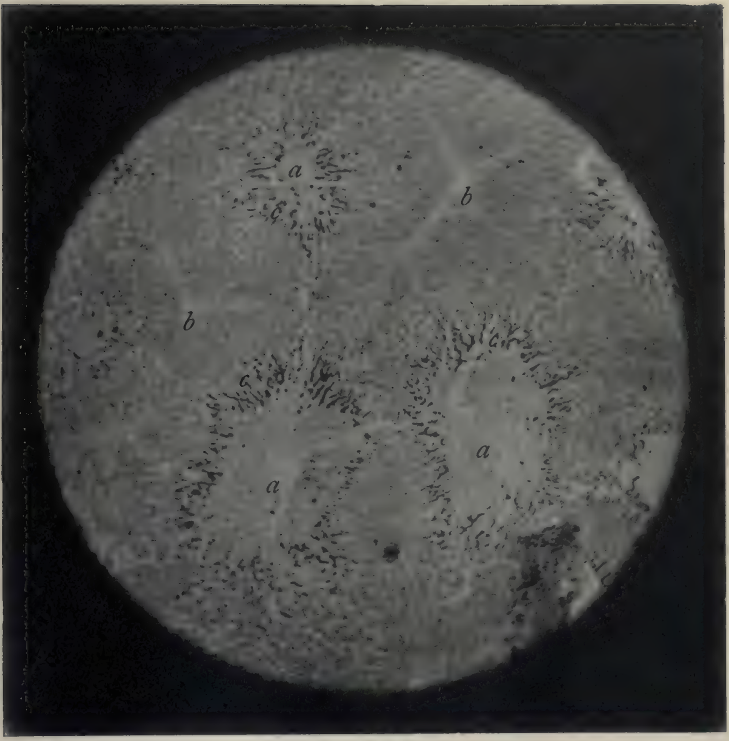
Plate II.



Microscopical section of the engorged liver in an acute case. Stained with hæmatoxylin-sudan III; magnified × 33.

a. Central vein.
b. Interlobular connective tissue.
c. The field where liver cells disappeared.
d. Liver cells with fatty degeneration (darker part).

Plate III.



Microscopical section of the engorged liver. An acute case.

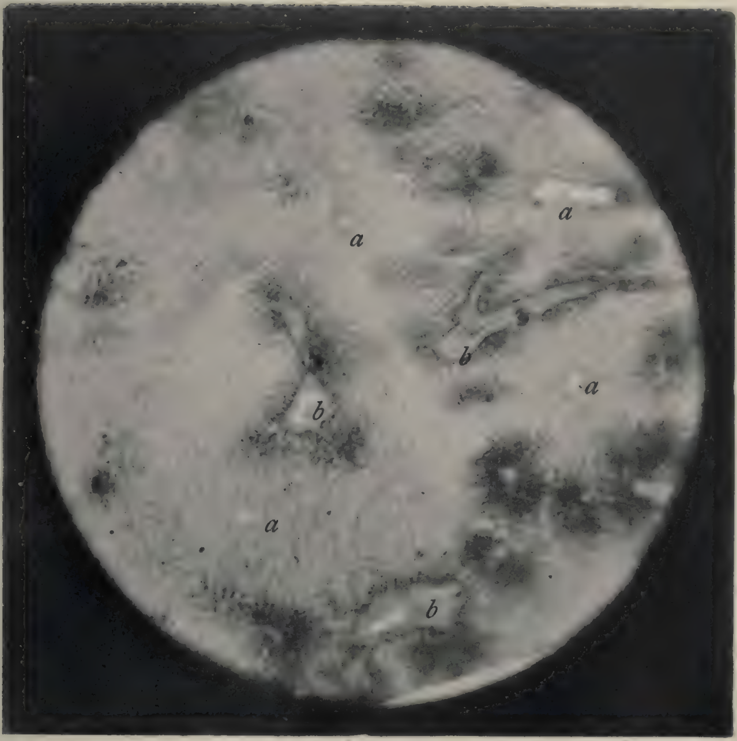
Stained with sudan III; magnified × 33.

a. Central vein, at its vicinity liver cells disappeared.

b. Interlobular connective tissue.

c. Liver cells with fatty degeneration.

Plate IV.

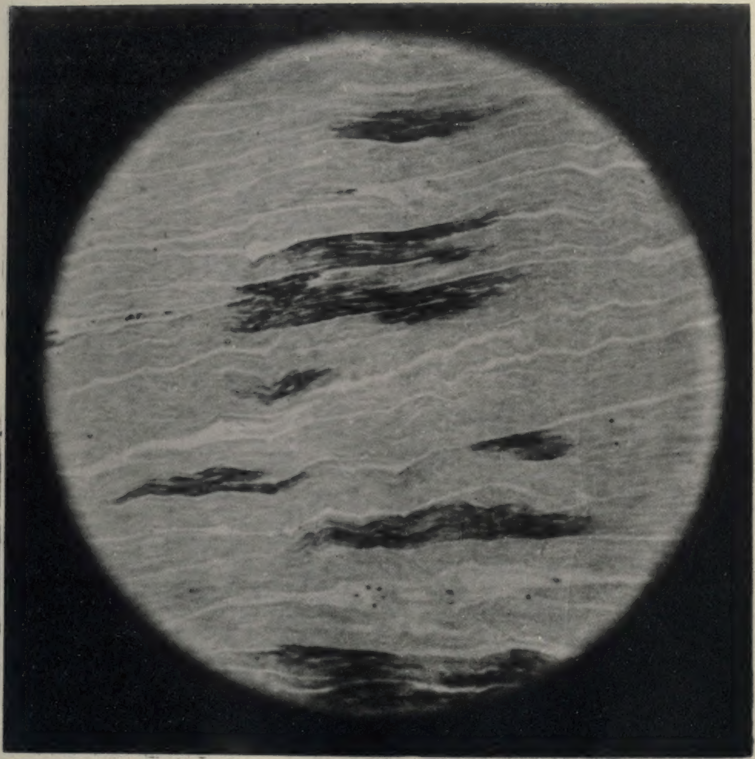


Microscopical section of the engorged liver. Advanced stage of an acute case. Magnified × 33.

a. Central vein.

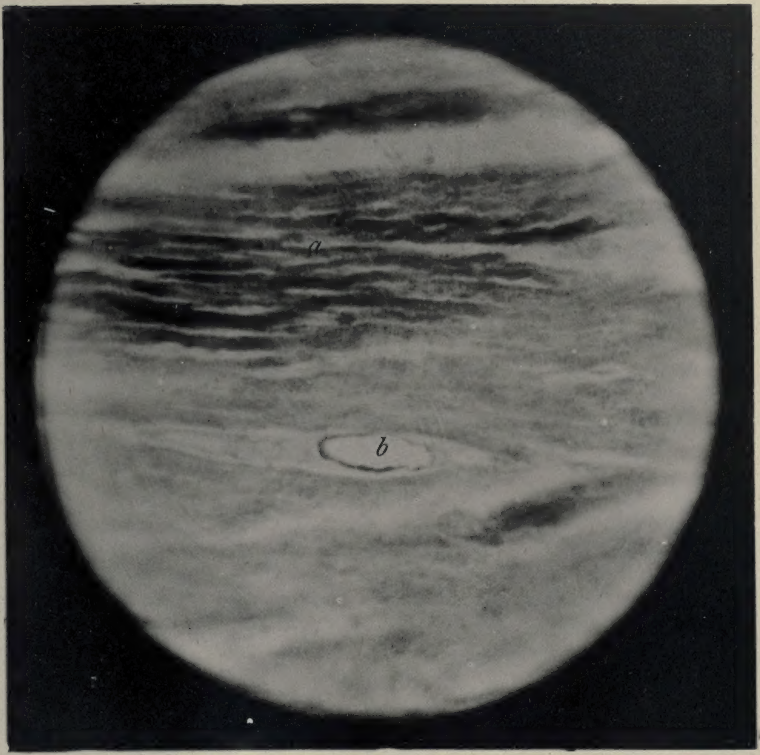
b. Island-like remain of liver cells around the interlobular connective tissue.

Plate V.



Microscopical section of the myocardium, showing the speckled fatty degeneration of fibers (darker part). Stained with sudan III; magnified × 33.

Plate VI.



Microscopical section of the myocardium, showing degenerated fibers and the small vein.

Stained with sudan III; magnified × 115.

a. Degenerated fibers.

b. Small vein.

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